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# Development of a Robust Setup for the Study of Wetting Characteristics of Low Melting Point Metals

John D. Casias
*University of Nebraska - Lincoln*, john.casias@huskers.unl.edu

Ethan Allan Davis
*University of Nebraska-Lincoln*, ethan.davis@huskers.unl.edu

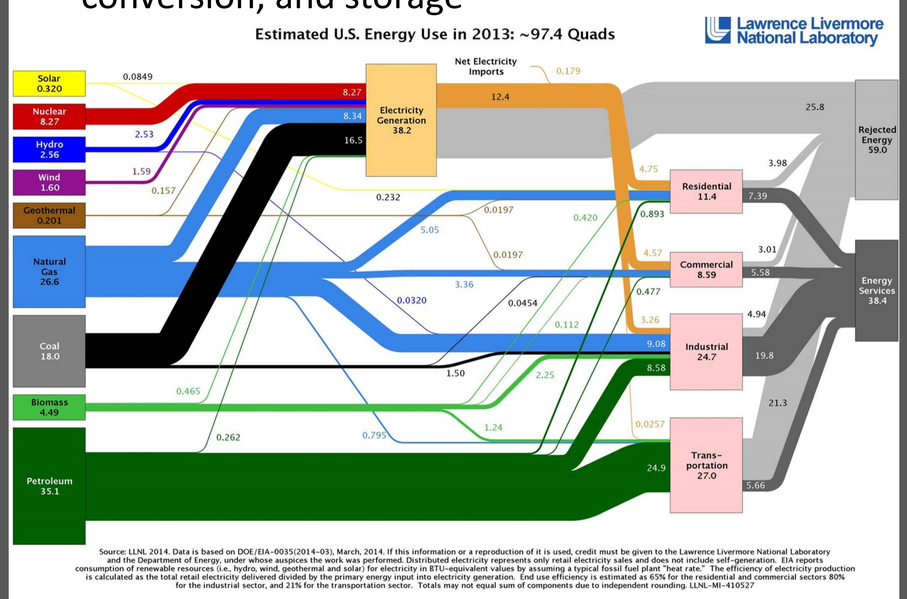
Sidy Ndao
*University of Nebraska-Lincoln*, sndao2@unl.edu

# Development of a Robust Setup for the Study of Wetting Characteristics of Low Melting Point Metals

John Casias, Ethan Davis, Sidy Ndao
Department of Mechanical and Materials Engineering
University of Nebraska – Lincoln, http://nmrl.unl.edu

## Motivation

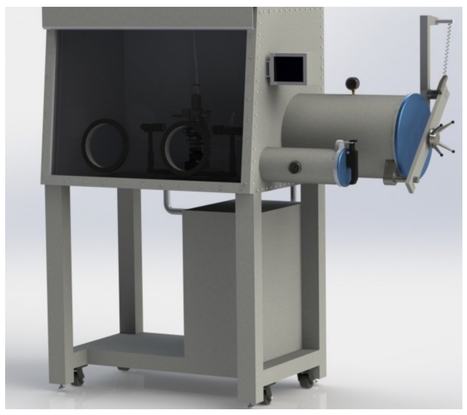
- Energy use is very inefficient
  - Approx. 60% rejected mostly in the form of waste heat
- Low melting point metals are promising for applications in thermal energy management, conversion, and storage




**Above**: Energy use in the US for the year 2013. The figure shows approximately 60% of energy is rejected.
**Retrieved from:** www.llnl.gov/missions/energy

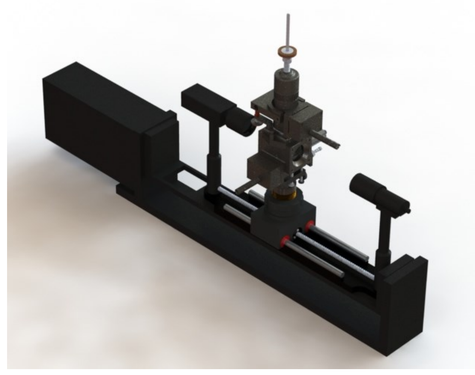
## Experimental Equipment

### MBRAUN LABstar Glove Box



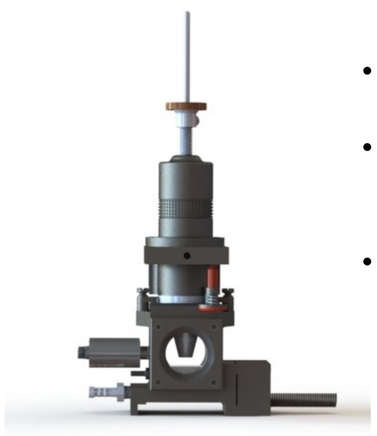
- Inert gas environment
- $O_2$ levels < 0.5 ppm
- $H_2O$ levels < 0.5 ppm
- Pressure control

### Rame-Hart Model 250 Goniometer



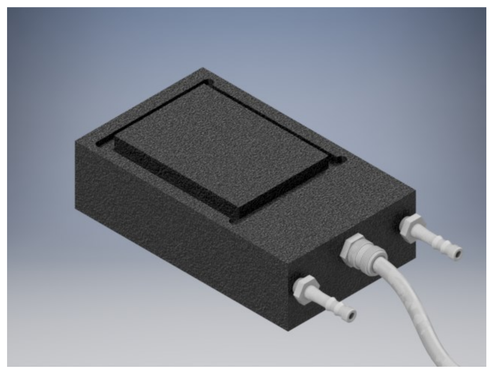
- Measures
  - Contact angle
  - Surface tension
- Adjustable stage

### Rame-Hart Elevated Temperature Syringe



- Provides an elevated temperature up to 300° C
- Fluid may be dispensed at a temperature equivalent to the sample surface
- Reduces the temperature gradient across the droplet

### Rame-Hart Hot Plate



- Provides an elevated sample temperature up to 300° C
- Can be cooled to well below ambient temperature

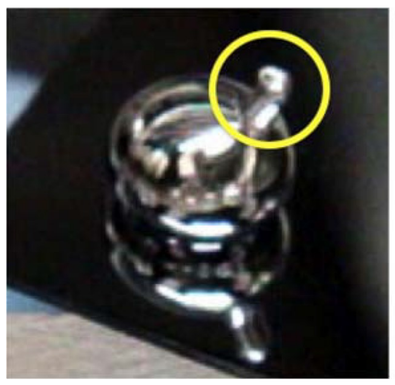
## Low Melting Point Metals

### Appealing Properties

- High thermal conductivity
- Low melting temperature
- Good electrical conductivity
- Small volume expansion during phase change
- High boiling point
- Large latent heat of phase change

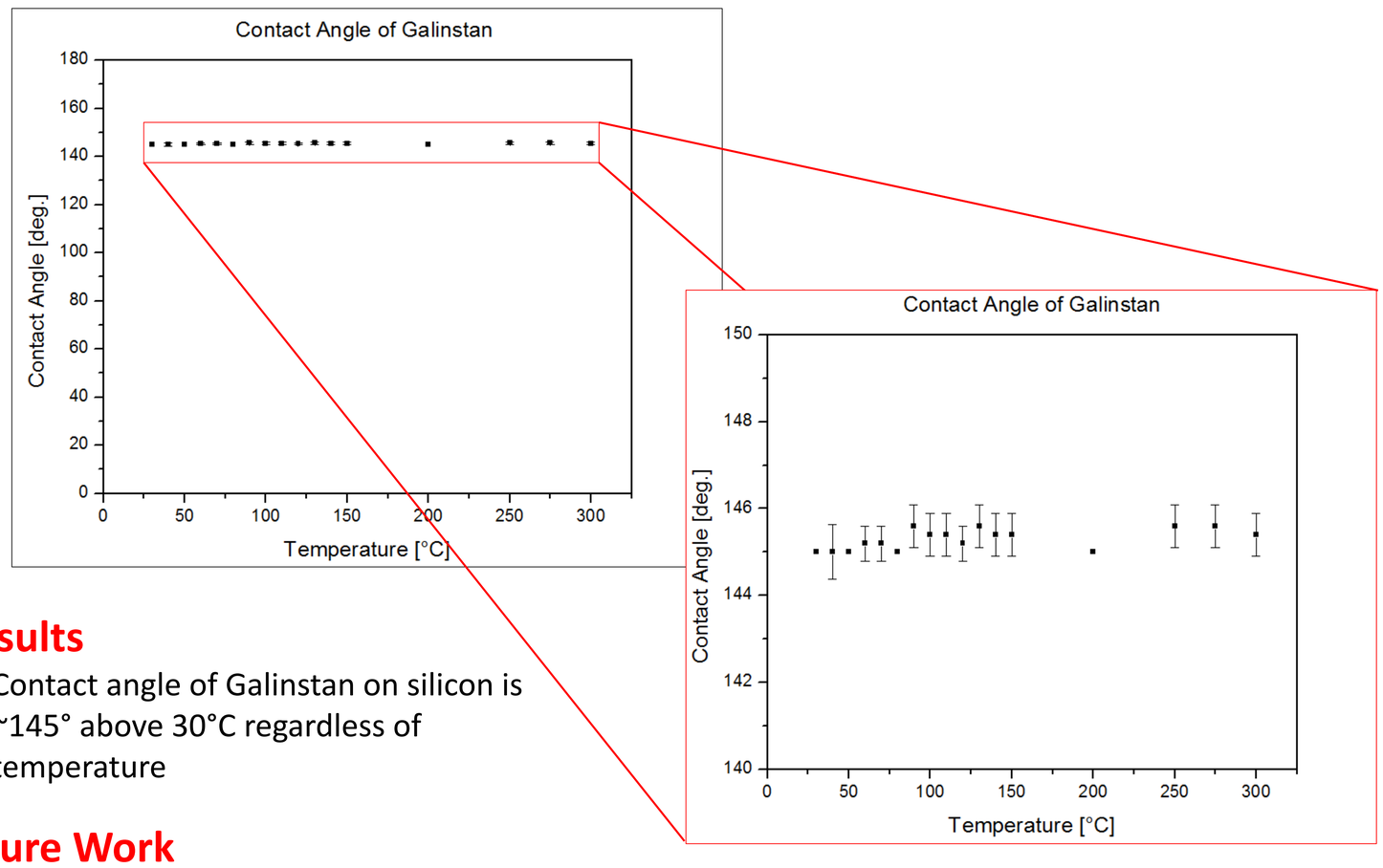
### Adverse Characteristics

- Oxidize readily at > 1 ppm oxygen
  - Must be handled in inert environment



Liu, T.; Sen, P.; Kim, C. J. Characterization of Nontoxic Liquid-Metal Alloy Galinstan for Applications in Microdevices. *J. Microelectromechanical Syst.* **2012**, *21*, 443–450.

## Preliminary Results and Future Work




### Results

- Contact angle of Galinstan on silicon is ~145° above 30°C regardless of temperature

### Future Work

- Contact angles of Galinstan below ambient
- Various substrate materials
  Tungsten, Pyrex, Tantalum, etc.
- Various low melting point metals.
  Gallium, Indium, Tin, Bismuth alloys

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## Acknowledgements

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